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(54) Semiconductor memory cell

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Description**BACKGROUND OF THE INVENTION****5 FIELD OF THE INVENTION**

[0001] The present invention relates to a semiconductor memory cell consisting of two transistors or one transistor formed by combining two transistors.

10 DESCRIPTION OF THE PRIOR ART

[0002] Fig. 12 shows a conventional dynamic memory cell consisting of a single transistor and a capacitor; the memory cell of this structure is generally known as a one-transistor memory cell and used as a semiconductor memory cell suitable for high density devices. In such a memory cell, the capacitance of the capacitor needs to be high enough to cause a voltage change on the associated bit line. However, the trend to smaller plan area of the semiconductor memory cell necessitates a reduction in the size of the capacitor formed in a horizontal plate-like shape, giving rise to the problem that when reading information stored as a charge on the memory cell capacitor, the information is masked by noise, or that, because of increasing stray capacitance on the bit line with each generation of memory cells, only a small voltage change can be caused to the bit line. In one approach to solving this problem, there is proposed a dynamic memory cell having a trench capacitor cell structure (see Fig. 13) or a stacked capacitor cell structure. However, because of processing limitations on how deep the trench can be formed and how high the stack (stacked layers) can be made, there is a limit to increasing the capacitance of the capacitor. Accordingly, it is said that dynamic memory cells of these structures encounter the limit of miniaturization in the dimensional region beyond the low submicron rule.

[0003] Furthermore, with transistors forming the semiconductor memory cells, reducing the transistor's plan area beyond the low submicron rule would introduce such problems as dielectric strength degradation, punch-through, etc., which would increase the possibility of leakage even under the rated voltage condition. With conventional transistor structures, therefore, it becomes difficult to ensure proper operation of the memory cell when the memory cell size is reduced.

[0004] To overcome the above limitations on the capacitance, there is proposed a memory cell structure wherein the memory cell is constructed with two transistors and the transistor channel current is sensed.

[0005] In the memory cell disclosed in Japanese Patent Unexamined Publication No. 63-19847, for example, a capacitor C_2 coupled to the gate and drain of a MOS transistor Q_1 is connected to a word line, as shown in Fig. 3 accompanying the same Patent Publication. Furthermore, the drain of the transistor Q_1 is connected to the gate of an SOI transistor Q_2 of the complementary type to the transistor Q_1 . The drain of the transistor Q_2 is in turn connected to a fixed potential V_D , while the source of each of the transistors, Q_1 and Q_2 , is connected to a bit line.

[0006] In the memory cell disclosed in the above Patent Publication, since the gate electrode of the SOI (silicon-on-insulator) transistor Q_2 is formed only on one principal surface side of the channel region thereof having two principal surfaces, an extra capacitor C_2 is needed to complete the structure of the memory cell. A further problem is that because of the charge or electric field applied (through an insulating film) to the other principal surface of the channel region of the SOI transistor Q_2 , the operation of the SOI transistor Q_2 becomes unstable and it is difficult to reduce the channel length.

[0007] On the other hand, the memory cell disclosed in Japanese Patent Unexamined Publication No. 1-145850 is constructed with a write transistor 18, a read transistor 19 (an SOI transistor), and a protective diode 20, as shown in Fig. 1 accompanying the same Patent Publication. The source of the write transistor 18 is connected to the gate of the read transistor 19. The cathode of the protective diode 20 is connected to the drain of the read transistor 19. Further, the anode of the protective diode 20 and the drain of the write transistor 18 are connected to a bit line, while the source of the read transistor 19 and the gate of the write transistor 18 are connected to a word line.

[0008] In the memory cell disclosed in the above Patent Publication, since the read transistor 19 is an SOI transistor, when the source potential is caused to change to the same polarity as the gate potential (when writing a "1") the potential of the channel region changes with the change of the gate potential, resulting in an incomplete writing condition. It is therefore difficult to read the "1" with the expected certainty. Furthermore, in the read transistor 19, the gate electrode is formed only on one principal surface side of the channel region having two principal surfaces. Therefore, this structure also has the problem that because of the charge or electric field applied (through an insulating film) to the other principal surface side of the channel region of the read transistor 19, the operation of the read transistor 19 becomes unstable and it is difficult to reduce the channel length.

[0009] The memory cells disclosed in Japanese Patent Unexamined Publication Nos. 62-141693 and 62-254462 each comprise a write transistor T1, a read transistor T2, and a storage capacitor C, as shown in Fig. 1 accompanying the former Patent Publication. The drains of the transistors T1 and T2 are connected to a bit line, and the source of the

transistor T1 is connected to the storage capacitor and also to a first gate of the transistor T2. Further, the gate of the transistor T1 is connected to a write selection line, while a second gate (or a channel forming region such as a well) of the transistor T2 is connected to a read selection line.

[0010] When the read transistor T2 is formed from an SOI transistor, the first and second gates are respectively formed on the upper and lower surface sides of the channel region of the transistor T2 (refer to Japanese Patent Application No. 55-93521 and Japanese Patent Unexamined Publication No. 57-18364). This structure eliminates the problem that has placed a limitation on the reduction of the channel length. For the write transistor T1, on the other hand, only bulk-type transistors are disclosed as preferred embodiments, and therefore, there is a limit to the miniaturization of the memory cell as a whole. Furthermore, the structure requiring each word line to be divided into a read line and a write line has the problem of increased chip area or increased number of stacked layers.

[0011] The present invention is concerned with the structure of a memory cell constructed with two transistors and yet capable of solving the above enumerated problems. An object of the invention is to provide a semiconductor memory cell, a semiconductor memory cell for ASICs (Application Specific Integrated Circuits), and even a semiconductor memory cell with a single transistor formed by combining two transistors, of the structure that ensures stable transistor operation, that does not require the provision of a large-capacitance capacitor as required in prior art DRAMs, and that allows the channel length to be reduced and achieves miniaturization of the cell.

[0012] The JP 02097063 describes a memory cell wherein a first MOS transistor is formed on a primary face of a semiconductor substrate and a single crystal semiconductor layer is formed on the first MOS transistor with an insulating film interposed. In the single crystal semiconductor layer a second MOS transistor is formed provided with a gate electrode formed on a channel region which is sandwiched in between diffusion regions. The channel region of the second MOS transistor is arranged just above an impurity region of the impurity regions of the first MOS transistor and the thickness of a semiconductor layer of the second MOS transistor channel region is so set as to enable the channel region to be completely depleted when the second MOS transistor is in operation. The preamble of claim 1 is based in this document.

[0013] In the US 4330849 a semiconductor memory device is disclosed which comprises a semiconductor substrate having a first conductivity type, first and second regions of a second conductivity type opposite to said first type formed in the surface of the semiconductor substrate and separated by a certain space therebetween, a third region of the first conductivity type in the second region, and a gate electrode formed on an insulating film on the semiconductor substrate between the first and the third regions. By applying a gate voltage to the gate electrode charge carriers are transferred between the first and second regions in accordance with the data to be stored. The stored data is read out by applying a prescribed gate voltage to the gate electrode and by detecting the value of the current between the third region and the semiconductor substrate.

[0014] The JP 57002563 describes a memory device which is composed of an N-channel MOS transistor and a P-channel MOS transistor and an N-type electrode commonly used for both transistors and P-type electrode to which a reference potential is applied and which is also commonly used.

[0015] In a device as disclosed in the JP 01145850 a first MOS transistor is used for writing and holding data which have been written and stored in the gate electrode that also serves as a capacitor part in a second MOS transistor.

SUMMARY OF THE INVENTION

[0016] To achieve the above object there is provided a semiconductor memory cell, as indicated in claim 1. It comprises:

an information storage transistor TR₁ comprising a semiconductor channel layer Ch₁ having first and second opposing principal surfaces; first and second conductive gates, G₁ and G₂, respectively disposed opposite the two principal surfaces of the semiconductor channel layer Ch₁ with first and second barrier layer respectively interposed therebetween; and first and second conductive regions, L₁ and L₂, respectively connected to either end of the semiconductor channel layer Ch₁, and

a switching transistor TR₂ comprising a semiconductor channel forming region Ch₂ having a third principal surface; a third conductive gate G₃ disposed opposite the third principal surface of the semiconductor channel forming region Ch₂ with a third barrier layer interposed therebetween; and third and fourth conductive layers, L₃ and L₄, each formed in a surface region of the semiconductor channel forming region Ch₂ and near either end of the third conductive gate G₃, wherein

the fourth conductive layer L₄ is connected to the second conductive gate G₂,

the first conductive gate G₁ and the third conductive gate G₃ are connected to a first memory-cell-selection line, the first conductive layer L₁ and the third conductive layer L₃ are connected to a second memory-cell-selection line, the second conductive layer L₂ is connected to a fixed potential including zero potential, and the semiconductor channel forming region Ch₂ is connected to a read/write selection line.

[0017] In the above structure, the conductive layers may be formed from a low-resistivity semiconductor, a silicide, a two-layered structure of silicide and semiconductor, a metal, or the like. The barrier layers serve as barriers to channel carriers, and may be formed from an insulating material or a wide-gap semiconductor material.

5 [0018] In one preferred mode of the semiconductor memory cell according to the first aspect of the invention, as shown in the schematic diagram of Fig. 4,

the information storage transistor TR₁ is formed from a transistor of a first conductivity type,
 the switching transistor TR₂ is formed from a transistor of a conductivity type opposite to the first conductivity type,
 10 the first conductive layer L₁ is connected to the second line via a fifth conductive layer L₅ which forms a rectifier junction with the first conductive layer L₁, and
 the semiconductor channel forming region Ch₂ is connected to a second fixed potential including zero potential.

15 [0019] To achieve the above object, in accordance with a second aspect of the invention, there is provided a semiconductor memory cell, as shown in the schematic diagram of Fig. 7, comprising:

an information storage transistor TR₁ comprising a first semiconductor channel layer Ch₁ having first and second opposing principal surfaces; first and second conductive gates, G₁ and G₂, respectively disposed opposite the two principal surfaces of the first semiconductor channel layer Ch₁ with first and second barrier layers respectively interposed therebetween; and first and second conductive regions, L₁ and L₂, each connected to either end of the first semiconductor channel layer Ch₁, and
 20 a switching transistor TR₂ comprising a second semiconductor channel layer Ch₂ having third and fourth opposing principal surfaces; third and fourth conductive gates, G₃ and G₄, respectively disposed opposite the two principal surfaces of the second semiconductor channel layer Ch₂ with third and fourth barrier layers respectively interposed therebetween; and third and fourth conductive layers, L₃ and L₄, each connected to either end of the second semiconductor channel region Ch₂, wherein
 25 the fourth conductive layer L₄ is connected to the second conductive gate G₂,
 the first conductive gate G₁ and the third conductive gate G₃ are connected to a first memory-cell-selection line, the first conductive layer L₁ and the third conductive layer L₃ are connected to a second memory-cell-selection line, the second conductive layer L₂ is connected to a fixed potential including zero potential, and
 30 the fourth conductive gate G₄ is connected to a read/write selection line.

[0020] In one preferred mode of the semiconductor memory cell according to the second aspect of the invention, as shown in the schematic diagram of Fig. 10,

35 the information storage transistor TR₁ is formed from a transistor of a first conductivity type,
 the switching transistor TR₂ is formed from a transistor of a conductivity type opposite to the first conductivity type, .
 the first conductive layer L₁ is connected to the second line via a fifth conductive layer L₅ which forms a rectifier junction with the first conductive layer L₁, and
 the fourth conductive gate G₄ is connected to a second fixed potential including zero potential.

40 [0021] In the semiconductor memory cell of the present invention, one conductive gate of the information storage transistor and one conductive gate of the switching transistor are connected to the first memory-cell-selection line. The first memory-cell-selection line, therefore, need not be provided more than one, and the chip area can be reduced.

[0022] In the semiconductor memory cell of the first and second aspects of the present invention, the fourth conductive layer is connected to the second conductive gate. When writing information, the switching transistor conducts, and the information is stored in the form of a potential or charge on the second conductive gate of the information storage transistor. The threshold voltage of the information storage transistor required at the first conductive gate, when reading information, varies depending on the potential or charge (information) stored on the second conductive gate. This is because the space-charge regions overlap across the channel layer near the first and second gates. Therefore, 50 when reading information, the operation of the information storage transistor can be controlled by applying an appropriately selected potential to the first conductive gate. Information reading is accomplished by sensing the operating condition (for example, magnitude of the channel current) of the information storage transistor.

[0023] In the information storage transistor, a conductive gate is provided opposite each of the two principal surfaces of the semiconductor channel layer. This structure stabilizes the operation of the information storage transistor and facilitates short-channel transistor design. This also eliminates the need for a large capacitor as required in prior art DRAMs.

[0024] The gate threshold voltage of the switching transistor is controlled by the potential applied to the read/write selection line. When writing information, the switching transistor is turned on in order to store the potential or charge on

the second conductive gate, and when the write operation is completed, it is turned off. The stored information is retained as a potential or charge on the second conductive gate until the information is read out.

5 [0025] In the semiconductor memory cell according to the second aspect of the present invention, the switching transistor has the fourth conductive gate. This serves to further stabilize the operation of the switching transistor. This is achieved by applying to the read/write selection line a signal for putting the switching transistor in an off condition without fail during information read operation.

[0026] When writing information, the first line is set at a potential high enough to turn on the switching transistor, and the capacitor between the regions SC₁ and SC₃ of the switching transistor is charged depending on the potential on the second line. As a result, the information is stored in the channel forming region (the second semiconductor

10 region SC₃) of the information storage transistor in the form of a charge or a potential difference from the region SC₁.

[0027] When reading information, the region SC₁ is supplied with a read potential, and the potential or charge (information) stored in the channel forming region of the information storage transistor is converted to a charge or a potential difference between the second semiconductor region SC₃, which corresponds to the channel forming region Ch₁, and the second conductive region SC₄, which corresponds to a source/drain region. The threshold voltage of the 15 information storage transistor required at the conductive gate varies depending on the charge (information). Therefore, the on/off operations of the information storage transistor can be controlled, when reading information, by applying an appropriately selected potential to the conductive gate. Information reading is accomplished by sensing the operating condition of the information storage transistor.

[0028] In the semiconductor memory cell of the invention, the stored information is retained in the form of a potential, potential difference, or charge, but since the stored information decays with time because of leakage currents due to junction leaks, etc., refreshing is necessary, and the memory cell operates in the same manner as other DRAM cells.

BRIEF DESCRIPTION OF THE DRAWINGS

25 [0029]

Fig. 1 is a diagram showing the principle of operation of a semiconductor memory cell according to a first aspect of the present invention.

30 Fig. 2 is a schematic cross-sectional view of a portion of a semiconductor memory cell according to Embodiment 1 of the present invention.

Fig. 3 is a diagram showing a modified example of Embodiment 1.

Fig. 4 is a diagram showing the principle of operation of a semiconductor memory cell according to a preferred mode of the first aspect of the invention.

35 Fig. 5 is a schematic cross-sectional view of a portion of a semiconductor memory cell according to Embodiment 2 of the present invention.

Fig. 6 is a diagram showing a modified example of Embodiment 2.

Fig. 7 is a diagram showing the principle of operation of a semiconductor memory cell according to a second aspect of the present invention.

40 Fig. 8 is a schematic cross-sectional view of a portion of a semiconductor memory cell according to Embodiment 3 of the present invention.

Fig. 9 is a diagram showing a modified example of Embodiment 3.

Fig. 10 is a diagram showing the principle of operation of a semiconductor memory cell according to a preferred mode of the second aspect of the present invention.

45 Fig. 11 is a schematic cross-sectional view of a portion of a semiconductor memory cell according to Embodiment 4 of the present invention.

Fig. 12 is a conceptual diagram showing a prior art one-transistor memory cell.

Fig. 13 is a cross-sectional view of a memory cell having a prior art trench capacitor cell structure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

50 [0030] The semiconductor memory cell of the invention will be described below in accordance with preferred embodiments thereof.

EMBODIMENT 1

55 [0031] Embodiment 1 is concerned with a semiconductor memory cell according to a first aspect of the invention. The semiconductor memory cell, the principle of operation of which is shown in Fig. 1 and cross sections of a portion of which are shown schematically in Figs. 2 and 3, comprises an information storage transistor TR₁ and a switching

transistor TR₂.

[0032] The information storage transistor TR₁ comprises a semiconductor channel layer Ch₁, a first conductive gate G₁, a second conductive gate G₂, and first and second conductive layers, L₁ and L₂, each connected to either end of the semiconductor channel layer Ch₁. The switching transistor TR₂ comprises a semiconductor channel forming

5 region Ch₂, a third conductive gate G₃, and third and fourth conductive layers, L₃ and L₄, each formed in the surface area of the semiconductor channel forming region Ch₂ in contacting relationship forming a rectifier junction therewith. The third conductive gate G₃ is formed in such a manner as to bridge the third conductive layer L₃ and the fourth conductive layer L₄.

[0033] The semiconductor channel layer Ch₁ has two opposing principal surfaces, the first principal surface MS₁ and the second principal surface MS₂. The first conductive gate G₁ is formed opposite the principal surface MS₁ of the semiconductor channel layer with a first barrier layer BL₁, interposed therebetween. Likewise, the second conductive gate G₂ is formed opposite the principal surface MS₂ of the semiconductor channel layer with a second barrier layer BL₂ interposed therebetween. The semiconductor channel forming region Ch₂ has a third principal surface MS₃. The third conductive gate G₃ is formed opposite the third principal surface MS₃ of the semiconductor channel forming region Ch₂ with a third barrier layer BL₃ interposed therebetween.

[0034] The fourth conductive layer L₄ is connected to the second conductive gate G₂. The first conductive gate G₁ and the third conductive gate G₃ are connected to a first memory-cell-selection line (for example, a word line). In the structural example shown in Fig. 2, the first conductive gate G₁ and the third conductive gate G₃ are common. The first conductive layer L₁ and the third conductive layer L₃ are connected to a second memory-cell-selection line (for example, a bit line). The second conductive layer L₂ is connected to a fixed potential including zero potential. The semiconductor channel forming region Ch₂ is connected to a read/write selection line. The read/write selection line may be a common well or a substrate. In Embodiment 1, a common well is used. The second memory-cell-selection line (for example, a bit line) need not be provided more than one, and the chip area can be reduced.

[0035] The conductive layers may be formed from a low-resistivity semiconductor, a silicide, a two-layered structure of silicide and semiconductor, a metal or the like. The barrier layers serve as barriers to channel carriers, and may be formed from an insulating material or a wide-gap semiconductor material.

[0036] In Embodiment 1, the information storage transistor TR₁ has an SOI structure. That is, with the multilayered structure shown in Fig. 2, the total area that the information storage transistor and the switching transistor take up can be made approximately equal to the area that one transistor takes up, thus allowing the chip area to be reduced.

30 [0037] The operation of the semiconductor memory cell will be described below, taking for example a case in which the information storage transistor TR₁ and the switching transistor TR₂ are both n-type transistors.

[0038] Potentials applied to the various lines for a memory write are designated as follows:

First memory-cell-selection line (e.g., word line) : V_W

35 Second memory-cell-selection line (e.g., bit line) "0" write : V₀

"1" write : V₁

Read/write selection line : V_{B_W}

[0039] Potentials applied to the various lines for a memory read are designated as follows. Note that during a read 40 cycle, the read/write selection line is reverse biased.

First memory-cell-selection line (e.g., word line) : V_R

Read/write selection line : V_{B_R}

45 [0040] For read/write, the fixed potential to which the second conductive layer L₂ is connected is designated as follows:

Fixed potential to which the second conductive layer L₂ is connected : V₂

50 [0041] The threshold voltages of the information storage transistor TR₁ required at the first conductive gate G₁ for memory read/write operations are designated as follows:

"0" read/write : V_{TH1_0}

"1" read/write : V_{TH1_1}

55 [0042] The potential of the second conductive gate G₂ is different between a "0" read/write and a "1" read/write. As a result, the threshold voltage of the information storage transistor TR₁ required at the first conductive gate G₁ differs between a "0" read/write and a "1" read/write. The information storage transistor TR₁ is provided with two conductive

gates, G_1 and G_2 , on opposite sides of the semiconductor channel layer Ch_1 ; this structure serves to stabilize the operation of the information storage transistor TR_1 , and facilitates short-channel design. Furthermore, a capacitor having a large capacitance as required in prior art DRAMs is not required.

[0043] The threshold voltage of the switching transistor TR_2 required at the third conductive gate G_3 for a write operation is designated as V_{TH2_W} . Further, the threshold voltage of the switching transistor TR_2 required at the third conductive gate G_3 for a read operation is designated as V_{TH2_R} . The threshold voltage of the switching transistor TR_2 required at the third conductive gate G_3 is different between memory write and memory read because the potential applied to the read/write selection line differs between write and read operations.

[0044] The relationships between the various potentials are set as follows:

10

$$|V_W| > |V_{TH2_W}|$$

15

$$|V_{TH1_0}| > |V_R| > |V_{TH1_1}|$$

$$|V_{TH2_R}| > |V_R|$$

[0045] The operation of the semiconductor memory cell of Embodiment 1 will be described below.

Information write

20

[0046] When writing information "0" (second line potential: V_0) or "1" (second line potential: V_1), the potential of the first line is V_W . Therefore, the potential at the third conductive gate G_3 of the switching transistor TR_2 is also V_W . Since the potential of the read/write selection line is V_{B_W} , the threshold voltage, V_{TH2_W} , of the switching transistor TR_2 required at the third conductive gate has the following relationship with respect to V_W .

25

$$|V_W| > |V_{TH2_W}|$$

As a result, the switching transistor TR_2 is ON. Therefore, the potential at the second conductive gate G_2 of the information storage transistor TR_1 is V_0 (when writing information "0") or V_1 (when writing information "1").

30

[0047] When writing information, the potential at the first conductive gate G_1 of the information storage transistor TR_1 is V_W . The threshold voltage of the information storage transistor TR_1 required at the first conductive gate G_1 is V_{TH1_0} or V_{TH1_1} . If the relationship

$$|V_W| > |V_{TH1_0}| > |V_{TH1_1}|$$

35

exists between these potentials, the information storage transistor TR_1 is also ON, but writing is performed whether the information storage transistor TR_1 is ON or OFF.

40

[0048] As described above, when writing information "0" or "1", the potential at the second conductive gate G_2 of the information storage transistor TR_1 is V_0 or V_1 . That is, the second conductive gate G_2 is held at a potential corresponding to the information "0" or "1", and this condition is substantially maintained within a prescribed time until the information is read out. During the information retention period after the information is written and before the information is read out, the various portions of the information storage transistor TR_1 and the switching transistor TR_2 are set at such potentials that neither transistor will conduct.

45

Information read

50

[0049] When reading information "0" or "1", the potential of the first line is V_R . Therefore, the potential at the third conductive gate G_3 of the switching transistor TR_2 is V_R . Since the potential of the read/write selection line is V_{B_R} , a reverse bias is applied between the source and the channel forming region of the switching transistor TR_2 . V_{B_R} is set so that the threshold voltage, V_{TH2_R} , of the switching transistor TR_2 required at the third conductive gate has the following relationship with respect to V_R .

$$|V_{TH2_R}| > |V_R|$$

55

The switching transistor TR_2 is thus held OFF.

[0050] When reading information, the potential at the first conductive gate G_1 of the information storage transistor TR_1 is V_R . The threshold voltage of the information storage transistor TR_1 at the first conductive gate G_1 is V_{TH1_0} or V_{TH1_1} . The threshold voltage of the information storage transistor TR_1 is dependent on the potential of the second con-

ductive gate G_2 . The following relationship exists between these potentials.

$$|V_{TH1_0}| > |V_R| > |V_{TH1_1}|$$

5 Therefore, when the stored information is "0", the information storage transistor TR_1 is OFF. On the other hand, when the stored information is "1", the information storage transistor TR_1 is ON.

[0051] Thus, the information storage transistor TR_1 is set to an ON or OFF condition, depending on the stored information. Therefore, when the stored information is "1", current flows to the second line; when the stored information is "0", no current but the leakage current flows to the second line. The stored information can be read in this manner by 10 the information storage transistor TR_1 .

[0052] The above-described operating conditions of the information storage transistor TR_1 and the switching transistor TR_2 are summarized in Table 1. The potential values given in Table 1 are only illustrative examples, and each potential can take any value as long as it satisfies the above conditions.

15

Table 1

		Unit: volts			
Memory write		"0" write		"1" write	
20	1st line potential	V_W	2.0	V_W	2.0
	2nd line potential	V_0	0	V_1	1.0
25	Read/write line		V_{B-W}		V_{B-W}
	Threshold of TR_2 required at 3rd gate	V_{TH2-W}	0.5	V_{TH2-W}	0.5
	3rd gate potential	V_W	2.0	V_W	2.0
30	Condition of TR_2	ON		ON	
	2nd gate potential	V_0	0	V_1	1.0
	Threshold of TR_1 required at 1st gate	V_{TH1-0}	1.1	V_{TH1-1}	0.5
35	1st gate potential	V_W	2.0	V_W	2.0
	Condition of TR_1	ON		ON	
<hr/>					
Memory read		"0" read		"1" read	
40	1st line potential	V_R	1.0	V_R	1.0
	Read/write line		V_{B-R}		V_{B-R}
	Threshold of TR_2 required at 3rd gate	V_{TH2-R}	1.5	V_{TH2-R}	1.5
	3rd gate potential	V_R	1.0	V_R	1.0
45	Condition of TR_2	OFF		OFF	
	2nd gate potential	V_0	0	V_1	1.0
	Threshold of TR_1 required at 1st gate	V_{TH1-0}	1.1	V_{TH1-1}	0.5
50	1st gate potential		1.0		1.0
	Condition of TR_2	OFF		ON	
	Fixed potential	V_2	0	V_2	0
	2nd line current	OFF		ON	

55 [0053] A modified example of the semiconductor memory cell of Embodiment 1 illustrated in Fig. 2 is shown schematically in cross section in Fig. 3. In the semiconductor memory cell shown in Fig. 2, the first conductive gate G_1 and the third conductive gate G_3 are common. By contrast, in the semiconductor memory cell shown in Fig. 3, the second conductive gate G_2 and the fourth conductive layer L_4 are common. Also, the read/write selection line is formed from a

well. While a slightly larger plan area is required as compared with the memory cell shown in Fig. 2, the memory cell shown in Fig. 3 have the advantages of relatively smooth surface topography, which is advantageous in lithography, and a less number of contacts.

5 EMBODIMENT 2

[0054] Embodiment 2 is concerned with a preferred mode of the semiconductor memory according to the first aspect of the invention. The semiconductor memory cell, the principle of operation of which is shown in Fig. 4 and cross sections of a portion of which are shown schematically in Figs. 5 and 6, comprises an information storage transistor TR₁ and a switching transistor TR₂. The structures of the information storage transistor TR₁ and the switching transistor TR₂ are fundamentally the same as those of Embodiment 1, except for the points hereinafter described.

[0055] The information transistor TR₁ is formed from a transistor of a first conductivity type, for example, a p-type transistor, and the switching transistor TR₂ is formed from a transistor of the opposite conductivity type to that of the information storage transistor TR₁, for example, an n-type transistor. In this case, if the first conductive layer L₁ and the second conductive layer L₂ are formed from semiconductor material, then their conductivity type should be p type. Likewise, if the first conductive gate G₁, the second conductive gate G₂, the third conductive gate G₃, the third conductive layer L₃, and the fourth conductive layer L₄ are formed from semiconductor material, then their conductivity type should be n⁺ type. Alternatively, these regions may be formed from a silicide, a two-layer structure of silicide and semiconductor, or a metal. The semiconductor channel forming region Ch₂ is connected to a second fixed potential including zero potential.

[0056] Further, the first conductive layer L₁ is connected to the second line via a fifth conductive layer L₅ which forms a rectifier junction with the first conductive layer. The provision of the fifth conductive layer serves to prevent without fail a current from flowing into the information storage transistor TR₁ during the writing of information. Furthermore, there is no possibility of the information write voltage being applied to the information storage transistor TR₁ and thereby interfering with the write operation as was the case with the prior art.

[0057] The operation of the semiconductor memory cell of Embodiment 2 will be described below.

[0058] The potentials of the information storage transistor TR₁ and the switching transistor TR₂ are set to satisfy the following relationships.

$$30 \quad |V_W| > |V_{TH2_W}|$$

$$|V_{TH1_1}| > |V_R| > |V_{TH1_0}|$$

Information write

[0059] When writing information "0" (second line potential: V₀) or "1" (second line potential: V₁), the potential of the first line is V_W (>0). Therefore, the potential at the third conductive gate G₃ of the switching transistor TR₂ is also V_W (>0). Since the second fixed potential is V_{B_W}, if V_W is set as

$$40 \quad |V_W| > |V_{TH2_W} + V_0 \text{ or } V_1|$$

where V_{TH2_W} is the threshold voltage of the switching transistor TR₂ required at the third conductive gate G₃, then the switching transistor TR₂ is ON. Therefore, the potential at the second conductive gate G₂ of the information transistor TR₁ is V₀ (when writing information "0") or V₁ (when writing information "1").

[0060] When writing information, the potential at the first conductive gate G₁ of the information storage transistor TR₁ is V_W (>0). Therefore, when V₀ or V₁ < V_W - V_{TH1_1}, the information storage transistor TR₁ is OFF. Even if it is ON, current flow is blocked by the presence of the rectifier junction between the first conductive layer L₁ and the fifth conductive layer L₅.

[0061] As described above, when writing information "0" or "1", the potential at the second conductive gate G₂ of the information storage transistor TR₁ is V₀ or V₁. That is, the second conductive gate G₂ is held at a potential corresponding to the information "0" or "1", and this condition is substantially maintained until the information is read out. During the information retention period after the information is written and before the information is read out, the various portions of the information storage transistor TR₁ and the switching transistor TR₂ are set at such potentials that neither transistor will conduct.

55 Information read

[0062] When reading information "0" or "1", the potential of the first line is V_R (<0). Therefore, the potential at the

third conductive gate G_3 of the switching transistor TR_2 is $V_R (<0)$, and the switching transistor TR_2 remains OFF unless the potential of the second line is made more negative than $V_R - V_{TH2_R}$. Normally, for a read operation, the second line is set at a small potential and information is read by sensing the current.

[0063] The potential at the first conductive gate G_1 of the information storage transistor TR_1 is $V_R (<0)$. The threshold voltage of the information storage transistor TR_1 required at the first conductive gate G_1 is V_{TH1_0} or V_{TH1_1} . The threshold voltage of the information storage transistor TR_1 is dependent on the potential of the second conductive gate G_2 . The following relationship exists between these potentials.

$$|V_{TH1_1}| > |V_R| > |V_{TH1_0}|$$

10 Therefore, when the stored information is "0", the information storage transistor TR_1 is ON. On the other hand, when the stored information is "1", the information storage transistor TR_1 is OFF.

[0064] Thus, the information storage transistor TR_1 is set to an ON or OFF condition, depending on the stored information. The second conductive layer L_2 of the information storage transistor TR_1 is connected to the fixed potential (V_2); 15 therefore, when the stored information is "0", current flows to the second line, and when the stored information is "1", current does not flow to the second line. The stored information can be read in this manner by the information storage transistor TR_1 .

[0065] A cross section of a portion of the semiconductor memory cell of Embodiment 2 is shown schematically in Fig. 5. The semiconductor memory cell of Embodiment 2 is fundamentally the same as the semiconductor memory cell 20 shown in Fig. 2, except that the information storage transistor TR_1 and the switching transistor TR_2 are of different conductivity types and that the first conductive layer L_1 is connected to the second line via the n-type fifth conductive layer L_5 which forms a rectifier junction with the p-type first conductive layer L_1 .

[0066] Table 2 summarizes the operating conditions of the semiconductor memory cell in which the information storage transistor TR_1 is formed from a p-type transistor and the switching transistor TR_2 is formed from an n-type transistor.

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Table 2

Unit: volts					
Memory write		"0" write		"1" write	
5	1st line potential	V_W	1.5	V_W	1.5
10	2nd line potential	V_0	0	V_1	1.0
15	Read/write line		V_{B-W}		V_{B-W}
20	Threshold of TR_2 required at 3rd gate	V_{TH2-W}	0.5	V_{TH2-W}	0.5
25	3rd gate potential	V_W	1.5	V_W	1.5
30	Condition of TR_2	ON		ON	
35	2nd gate potential	V_0	0	V_1	1.0
	1st gate potential	V_W	1.5	V_W	1.5
	Condition of TR_1	OFF		OFF	
Memory read		"0" read		"1" read	
25	1st line potential	V_R	-1.0	V_R	-1.0
30	3rd gate potential	V_R	-1.0	V_R	-1.0
35	Condition of TR_2	OFF		OFF	
	2nd gate potential	V_0	0	V_1	1.0
	Threshold of TR_1 required at 1st gate	V_{TH1-0}	-0.5	V_{TH1-1}	-1.1
	1st gate potential		-1.0		-1.0
	Condition of TR_1	ON		OFF	
	Fixed potential		V_2		V_2
	2nd gate current	ON		OFF	

[0067] The potential values given in Table 2 are only illustrative examples, and each potential can take any value as long as it satisfies the above conditions.

[0068] A modified example of the semiconductor memory cell illustrated in Fig. 5 is shown schematically in cross section in Fig. 6. The semiconductor memory cell shown is fundamentally the same as the semiconductor memory cell shown in Fig. 3, except that the information storage transistor TR_1 and the switching transistor TR_2 are of different conductivity types and that the first conductive layer L_1 is connected to the second line via the n-type fifth conductive layer L_5 which forms a rectifier junction with the p-type first conductive layer L_1 .

45 Embodiment 3

[0069] Embodiment 3 is concerned with a semiconductor memory cell according to a second aspect of the invention. The semiconductor memory cell, the principle of operation of which is shown in Fig. 7 and cross sections of a portion of which are shown schematically in Figs. 8 and 9, comprises an information storage transistor TR_1 and a switching transistor TR_2 . The information storage transistor TR_1 comprises a first semiconductor channel layer Ch_1 , a first conductive gate G_1 , a second conductive gate G_2 , and first and second conductive layers, L_1 and L_2 , each connected to either end of the first semiconductor channel layer Ch_1 . The switching transistor TR_2 comprises a second semiconductor channel layer Ch_2 , a third conductive gate G_3 , a fourth conductive gate G_4 , and third and fourth conductive layers, L_3 and L_4 , each connected to either end of the second semiconductor channel layer Ch_2 . In Embodiment 3, the information storage transistor TR_1 and the switching transistor TR_2 both have an SOI structure (including a structure in which the barrier layer is formed from a wide-gap semiconductor, for example, GaAlAs as compared with GaAs).

[0070] The first semiconductor channel layer Ch_1 has two opposing principal surfaces, the first principal surface MS_1 and the second principal surface MS_2 . The first conductive gate G_1 is formed opposite the principal surface MS_1 .

of the first semiconductor channel layer with a first barrier layer BL₁ interposed therebetween. Likewise, the second conductive gate G₂ is formed opposite the principal surface MS₂ of the first semiconductor channel layer with a second barrier layer BL₂ interposed therebetween.

[0071] The second semiconductor channel layer Ch₂ has two opposing principal surfaces, the third principal surface MS₃ and the fourth principal surface MS₄. The third conductive gate G₃ is formed opposite the third principal surface MS₃ of the second semiconductor channel layer Ch₂ with a third barrier layer BL₃ interposed therebetween. Likewise, the fourth conductive gate G₄ is formed opposite the fourth principal surface MS₄ of the second semiconductor channel layer Ch₂ with a third barrier layer BL₄ interposed therebetween.

[0072] The fourth conductive layer L₄ is connected to the second conductive gate G₂. In Embodiment 3, the fourth conductive layer L₄ and the second conductive gate G₂ are common. The first conductive gate G₁ and the third conductive gate G₃ are connected to a first memory-cell-selection line (for example, a word line). The first conductive layer L₁ and the third conductive layer L₃ are connected to a second memory-cell-selection line (for example, a bit line). The second conductive layer L₂ is connected to a fixed potential including zero potential. The fourth conductive gate G₄ is connected to a read/write selection line.

[0073] The semiconductor memory cell of Embodiment 3 is different from the semiconductor memory cell of Embodiment 1 in that the switching transistor TR₂ has the fourth conductive gate G₄. This serves to further stabilize the operation of the switching transistor TR₂ and yet allows further miniaturization.

[0074] When the information storage transistor TR₁ and the switching transistor TR₂ are both n-type transistors, the operation of the semiconductor memory cell is the same as that described in Embodiment 1 (see Table 1), and therefore, detailed explanation thereof is not repeated here.

[0075] A modified example of the semiconductor memory cell of Embodiment 3 illustrated in Fig. 8 is shown schematically in cross section in Fig. 9. In the semiconductor memory cell shown in Fig. 8, the second conductive gate G₂ and the fourth conductive layer L₄ are common. By contrast, in the semiconductor memory cell shown in Fig. 9, the first conductive gate G₁ and the third conductive gate G₃ are formed in the same substrate surface. The first conductive gate G₁ and the third conductive gate G₃ may be connected to each other. While a slightly larger plan area is required than that of the memory cell shown in Fig. 8, the memory cell shown in Fig. 9 has the advantage that the first semiconductor channel layer Ch₁ and the second semiconductor channel layer Ch₂ can be formed using a single high-quality semiconductor layer whereas two such layers are needed in the structure of the semiconductor memory cell shown in Fig. 8. There is a further advantage that the first conductive gate G₁ and the third conductive gate G₃ can be made common.

30 Embodiment 4

[0076] Embodiment 4 is concerned with a preferred mode of the semiconductor memory cell according to the second aspect of the invention. The semiconductor memory cell, the principle of operation of which is shown in Fig. 10 and a cross section of a portion of which is shown schematically in Fig. 11, comprises an information storage transistor TR₁ and a switching transistor TR₂. The structures of the information storage transistor TR₁ and the switching transistor TR₂ are fundamentally the same as those of Embodiment 3, except for the points hereinafter described.

[0077] The information transistor TR₁ is formed from a transistor of a first conductivity type, for example, a p-type transistor, and the switching transistor TR₂ is formed from a transistor of the opposite conductivity type to that of the information storage transistor TR₁, for example, an n-type transistor. In this case, if the first conductive layer L₁ and the second conductive layer L₂ are formed from semiconductor material, then their conductivity type should be p type. Likewise, if the first conductive gate G₁, the second conductive gate G₂, the third conductive gate G₃, the fourth conductive gate G₄, the third conductive layer L₃, and the fourth conductive layer L₄ are formed from semiconductor material, then their conductivity type should be n⁺ type. The fourth conductive gate G₄ is connected to a second fixed potential including zero potential.

[0078] Further, the first conductive layer L₁ is connected to the second line via an n-type fifth conductive layer L₅ which forms a rectifier junction with the p-type first conductive layer L₁.

[0079] A cross section of a portion of the semiconductor memory cell of Embodiment 4 is shown schematically in Fig. 11. The semiconductor memory cell of Embodiment 3 is fundamentally the same as the semiconductor memory cell shown in Fig. 9, except that the first and second conductive layers, L₁ and L₂, are of different conductivity type and that the first conductive layer L₁ is connected to the second line via the n⁺ fifth conductive layer L₅ which forms a rectifier junction with the p-type first conductive layer L₁. In Fig. 11, the fifth conductive layer L₅ and the rectifier junction between the first conductive layer L₁ and the fifth conductive layer L₅ are shown in schematic form for simplicity. It will also be appreciated that the first conductive gate G₁ and the third conductive gate G₃ may be connected to each other.

[0080] When the information storage transistor TR₁ is formed from a p-type transistor and the switching transistor TR₂ from an n-type transistor, the operation of the semiconductor memory cell is the same as that described in Embodiment 2 (see Table 2), and therefore, detailed explanation thereof is not repeated here.

Claims**1. A semiconductor memory cell comprising:**

5 an information storage transistor (TR₁) comprising a semiconductor channel layer (Ch₁) having first and second opposing principal surfaces (MS₁, MS₂); first and second conductive gates (G₁, G₂) respectively disposed opposite said two principal surfaces (MS₁, MS₂) of said semiconductor channel layer (Ch₁) with first and second barrier layers (BL₁, BL₂) respectively interposed therebetween; and first and second conductive regions (L₁, L₂) each connected to either end of said semiconductor channel layer (Ch₁), and

10 a switching transistor (TR₂) comprising a semiconductor channel forming region (Ch₂) having a third principal surface (MS₃); a third conductive gate (G₃) disposed opposite said third principal surface (MS₃) of said semiconductor channel forming region (Ch₂) with a third barrier layer (BL₃) interposed therebetween; and third and fourth conductive regions (L₃, L₄) each formed in a surface region of said semiconductor channel forming region (Ch₂) in contacting relationship forming a rectifier junction therewith, said third conductive gate (G₃) being formed in such a manner as to bridge said third conductive region (L₃) and said fourth conductive region (L₄), wherein

15 said fourth conductive region (L₄) is connected to said second conductive gate (G₂), characterized in that said first conductive gate (G₁) and said third conductive gate (G₃) are connected to a first memory-cell-selection line (word line),

20 said first conductive layer (L₁) and said third conductive layer (L₃) are connected to a second memory-cell-selection line (bit line),

25 said second conductive layer (L₂) is connected to a fixed potential including zero potential, and
 said semiconductor channel forming region (Ch₂) is connected to a read/write selection line.

25 2. A semiconductor memory cell according to claim 1, wherein

30 said information storage transistor (TR₁) is formed from a transistor of a first conductivity type,
 said switching transistor (TR₂) is formed from a transistor of a conductivity type opposite to the first conductivity type,

35 said first conductive region (L₁) is connected to said second line via a fifth conductive region (L₅) which forms a rectifier junction with said first conductive region (L₁), and
 said semiconductor channel forming region (Ch₂) is connected to a second fixed potential including zero potential.

35 3. A semiconductor memory cell according to claim 1 wherein

40 said switching transistor (TR₂) comprises a fourth conductive gate (G₄) disposed opposite said third conductive gate (G₃) on a second principal surface (MS₄) of said second semiconductor channel layer (Ch₂) with a fourth barrier layer (BL₄) interposed therebetween;

45 said fourth conductive gate (G₄) being connected to said read/write selection line instead of said semiconductor channel forming region (Ch₂).

4. A semiconductor memory cell according to claim 3, wherein

45 said information storage transistor (TR₁) is formed from a transistor of a first conductivity type,
 said switching transistor (TR₂) is formed from a transistor of a conductivity type opposite to the first conductivity type,
 said first conductive layer (L₁) is connected to said second line via a fifth conductive layer (L₅) which forms a rectifier junction with said first conductive layer (L₁), and
 said fourth conductive gate (G₄) is connected to a second fixed potential including zero potential.

Patentansprüche**55 1. Halbleiterspeicherzelle mit:**

- einem Informationsspeichertransistor (TR₁) mit einer Halbleiterkanalschicht (Ch₁) mit einer ersten und einer zweiten Hauptfläche (MS₁, MS₂), die voneinander abgewandt sind; einem ersten und einem zweiten leitenden

Gate (G_1, G_2), die den beiden Hauptflächen (MS_1, MS_2) der Halbleiterkanalschicht (Ch_1) jeweils gegenüberstehend angeordnet sind, wobei eine erste bzw. eine zweite Barrièreschicht (BL_1, BL_2) dazwischen eingefügt ist; und einem ersten und einem zweiten leitenden Bereich (L_1, L_2), von denen jeder mit einem Ende der Halbleiterkanalschicht (Ch_1) verbunden ist; und

- 5 - einem Schaltransistor (TR_2) mit einem einen Halbleiterkanal bildenden Bereich (Ch_2) mit einer dritten Hauptfläche (MS_3); einem dritten leitenden Gate (G_3), das der dritten Hauptfläche (MS_3) des den Halbleiterkanal bildenden Bereichs (Ch_2) gegenüberstehend angeordnet ist, wobei eine dritte Barrièreschicht (BL_3) dazwischen eingefügt ist; und einem dritten und einem vierten leitenden Bereich (L_3, L_4), die jeweils in einem Oberflächenbereich des den Halbleiterkanal bildenden Bereichs (Ch_2) in kontaktierender Beziehung, wobei mit diesem ein Gleichrichterübergang gebildet ist, ausgebildet ist, wobei das dritte leitende Gate (G_3) auf solche Weise ausgebildet ist, dass es den dritten leitenden Bereich (L_3) und den vierten leitenden Bereich (L_4) überbrückt; wobei
- 10 - der vierte leitende Bereich (L_4) mit dem zweiten leitenden Gate (G_2) verbunden ist; dadurch gekennzeichnet, dass
- das erste leitende Gate (G_1) und das dritte leitende Gate (G_3) mit einer ersten Speicherzelle-Auswählleitung (Wortleitung) verbunden sind;
- die erste leitende Schicht (L_1) und die dritte leitende Schicht (L_3) mit einer zweiten Speicherzelle-Auswählleitung (Bitleitung) verbunden sind;
- die zweite leitende Schicht (L_2) mit einem festen Potenzial, einschließlich dem Potenzial Null, verbunden ist; und
- 20 - der den Halbleiterkanal bildende Bereich (Ch_2) mit einer Lese/Schreib-Auswählleitung verbunden ist.

2. Halbleiterspeicherzelle nach Anspruch 1, bei der

- der Informationsspeichertransistor (TR_1) aus einem Transistor von erstem Leitungstyp besteht;
- 25 - der Schaltransistor (TR_2) aus einem Transistor von einem Leitungstyp entgegengesetzt zum ersten Leitungstyp besteht;
- der erste leitende Bereich (L_1) über einen fünften leitenden Bereich (L_5), der mit dem ersten leitenden Bereich (L_1) einen Gleichrichterübergang bildet, mit der zweiten Leitung verbunden ist; und
- der den Halbleiterkanal bildende Bereich (Ch_2) mit einem zweiten festen Potenzial, einschließlich dem Potenzial Null, verbunden ist.

3. Halbleiterspeicherzelle nach Anspruch 1, bei der

- der Schaltransistor (TR_2) ein vierter leitendes Gate (G_4) aufweist, das abgewandt vom dritten leitenden Gate (G_3) auf einer zweiten Hauptfläche (MS_4) der zweiten Halbleiterkanalschicht (Ch_2) ausgebildet ist, wobei dazwischen eine vierte Barrièreschicht (BL_4) eingefügt ist;
- 35 - wobei das vierte leitende Gate (G_4) mit der Lese/Schreib-Auswählleitung statt mit dem den Halbleiterkanal bildenden Bereich (Ch_2) verbunden ist.

40 4. Halbleiterspeicherzelle nach Anspruch 3, bei der ,

- der Informationsspeichertransistor (TR_1) aus einem Transistor von erstem Leitungstyp besteht;
- der Schaltransistor (TR_2) aus einem Transistor von einem Leitungstyp entgegengesetzt zum ersten Leitungstyp besteht;
- 45 - die erste leitende Schicht (L_1) über eine fünfte leitende Schicht (L_5), die mit der ersten leitenden Schicht (L_1) einen Gleichrichterübergang bildet, mit der zweiten Leitung verbunden ist; und
- das vierte leitende Gate (G_4) mit einem zweiten festen Potenzial, einschließlich dem Potenzial Null, verbunden ist.

50 Revendications

1. Cellule de mémoire à semiconducteur comprenant :

- 55 un transistor de mémorisation d'informations (TR_1) comprenant une couche de canal à semiconducteur (Ch_1) présentant des première et seconde surfaces principales opposées (MS_1, MS_2), des première et seconde grilles conductrices (G_1, G_2) disposées respectivement à l'opposé desdites deux surfaces principales de ladite couche de canal à semiconducteur (Ch_1), des première et seconde couches de barrière (BL_1, BL_2) étant respectivement intercalées entre celles-ci, et des première et seconde régions conductrices, (L_1, L_2), chacune

5 étant reliée à l'une ou l'autre extrémité de ladite couche de canal à semiconducteur (Ch_1), et
un transistor de commutation (TR_2) comprenant une région de formation de canal à semiconducteur (Ch_2) pré-
sentant une troisième surface principale (MS_3), une troisième grille conductrice (G_3) disposée à l'opposé de
ladite troisième surface principale (MS_3) de ladite région de formation de canal à semiconducteur (Ch_2), une
troisième couche de barrière (BL_3) étant intercalée entre celles-ci, et des troisième et quatrième régions con-
ductrices (L_3 , L_4), chacune étant formée dans une région de surface de ladite région de formation de canal à
semiconducteur (Ch_2) en relation de contact formant une jonction de redresseur avec celles-ci, ladite troisième
grille conductrice (G_3) étant formée de telle manière qu'elle pente ladite troisième région conductrice (L_3) et
ladite quatrième région conductrice (L_4), dans laquelle
10 ladite quatrième région conductrice (L_4) est reliée à la seconde grille conductrice (G_2), caractérisée en ce que
ladite première grille conductrice (G_1) et ladite troisième grille conductrice (G_3) sont reliées à une première
ligne de sélection de cellule de mémoire (ligne de mot),
ladite première couche conductrice (L_1) et ladite troisième couche conductrice (L_3) sont reliées à une seconde
ligne de sélection de cellule de mémoire (ligne de bit),
15 ladite seconde couche conductrice (L_2) est reliée à un potentiel fixe comprenant un potentiel zéro, et
ladite région de formation de canal à semiconducteur (Ch_2) est reliée à une ligne de sélection de lecture/écri-
ture.

2. Cellule de mémoire à semiconducteur selon la revendication 1, dans laquelle

20 ledit transistor de mémorisation d'informations (TR_1) est formé à partir d'un transistor d'un premier type de conductivité,
ledit transistor de commutation (TR_2) est formé à partir d'un transistor d'un type de conductivité opposé au premier type de conductivité,
25 ladite première région conductrice (L_1) est reliée à ladite seconde ligne par l'intermédiaire d'une cinquième région conductrice (L_5) qui forme une jonction de redresseur avec la première région conductrice (L_1), et ladite région de formation de canal à semiconducteur (Ch_2) est reliée à un second potentiel fixe comprenant un potentiel zéro.

30 3. Cellule de mémoire à semiconducteur selon la revendication 1, dans laquelle

35 ledit transistor de commutation comprend une quatrième grille conductrice (G_4) disposée à l'opposé de ladite troisième grille conductrice (G_3) sur une seconde surface principale (MS_4) de ladite seconde couche de canal à semiconducteur (Ch_2) avec une quatrième couche de barrière (BL_4) intercalée entre celles-ci, ladite quatrième grille conductrice (G_4) étant reliée à ladite ligne de sélection de lecture/écriture au lieu de ladite région de formation de canal à semiconducteur (Ch_2).

4. Cellule de mémoire à semiconducteur selon la revendication 3, dans laquelle

40 ledit transistor de mémorisation d'informations (TR_1) est formé à partir d'un transistor d'un premier type de conductivité,
ledit transistor de commutation (TR_2) est formé à partir d'un transistor d'un type de conductivité opposé au premier type de conductivité,
45 ladite première couche conductrice (L_1) est reliée à ladite seconde ligne par l'intermédiaire d'une cinquième couche conductrice (L_5) qui forme une jonction de redresseur avec ladite première couche conductrice (L_1), et ladite quatrième grille conductrice (G_4) est reliée à un second potentiel fixe comprenant un potentiel zéro.

FIG. 1

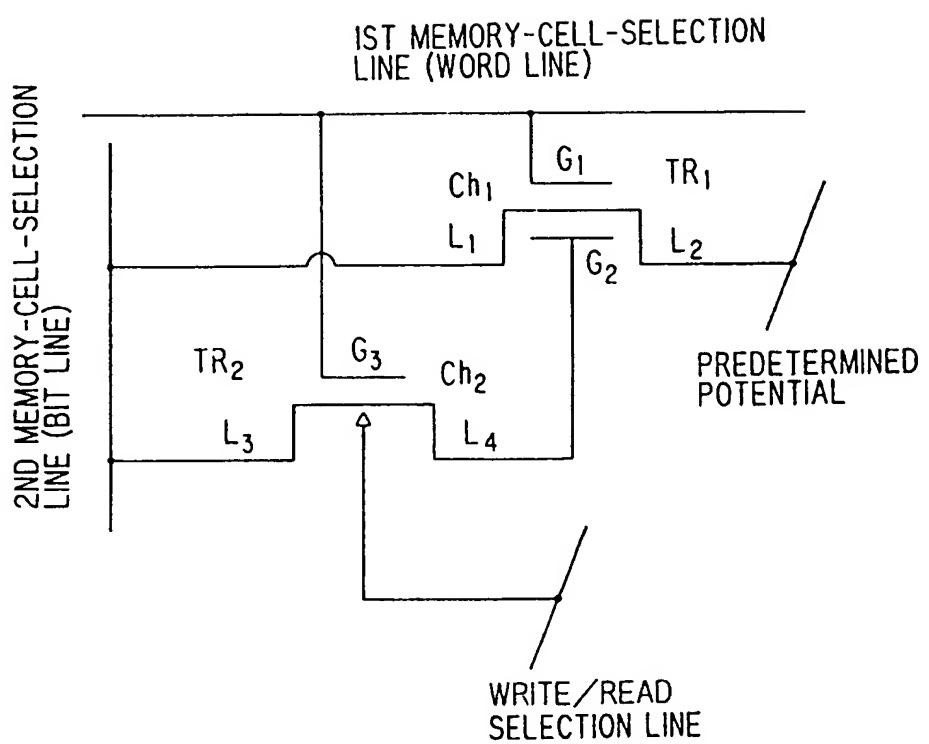


FIG. 2

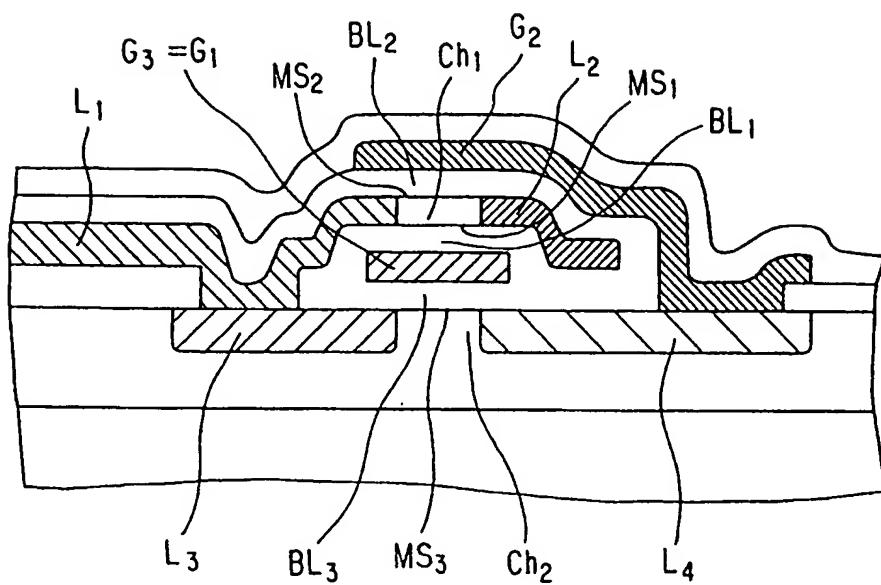


FIG. 3

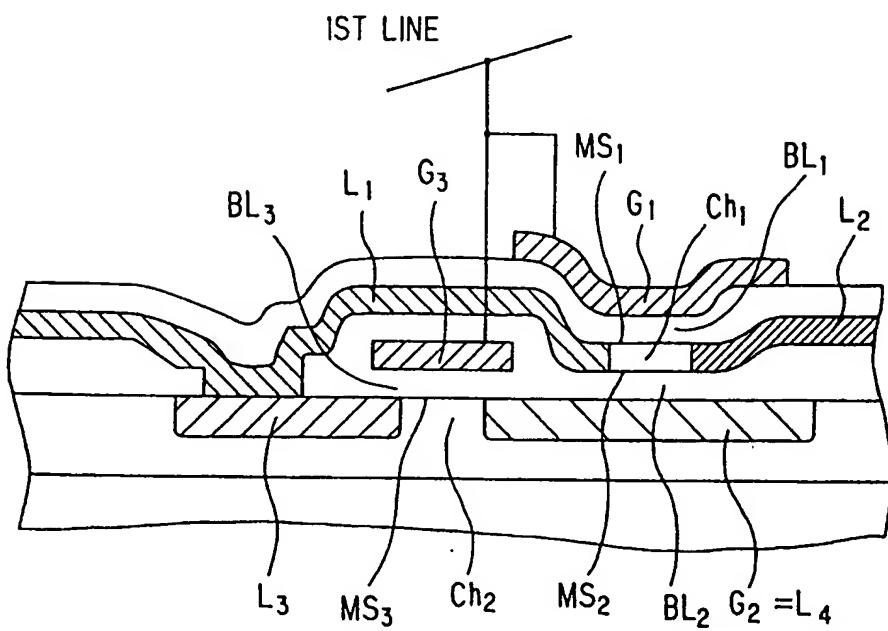


FIG. 4

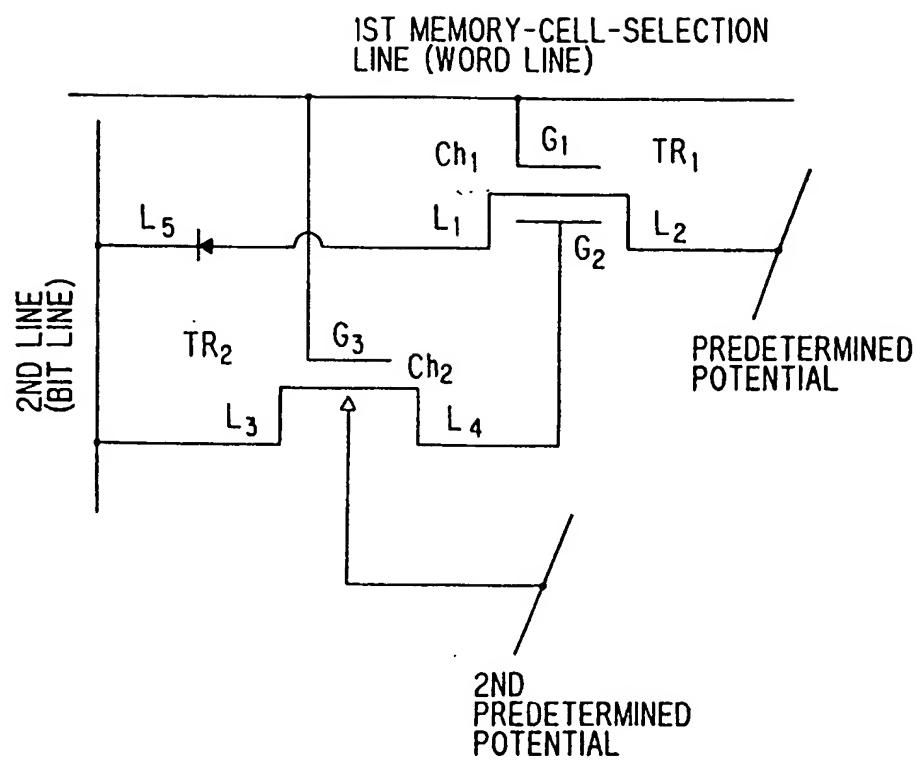


FIG. 5

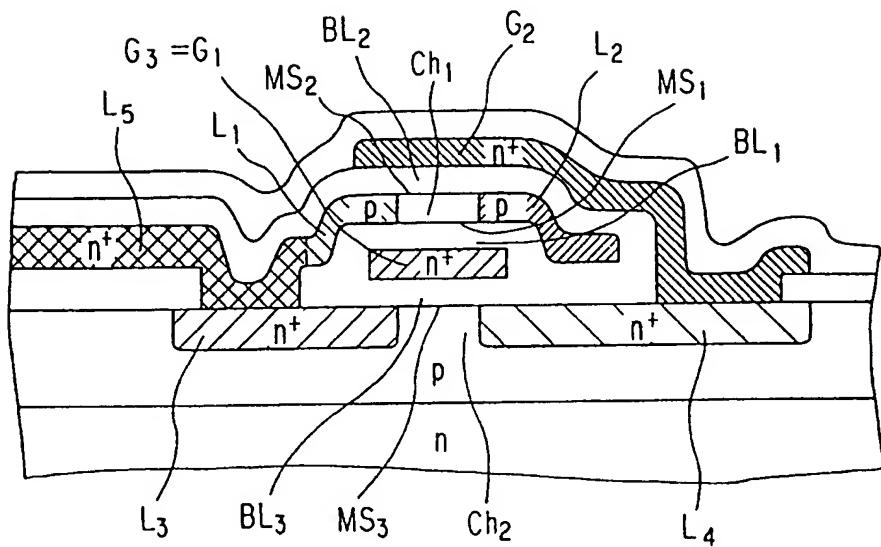


FIG. 6

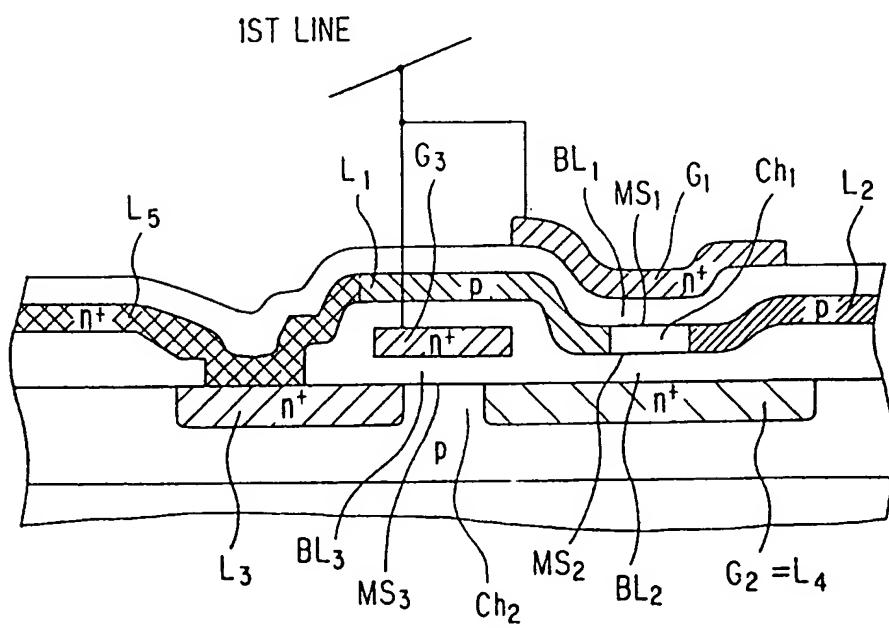


FIG. 7

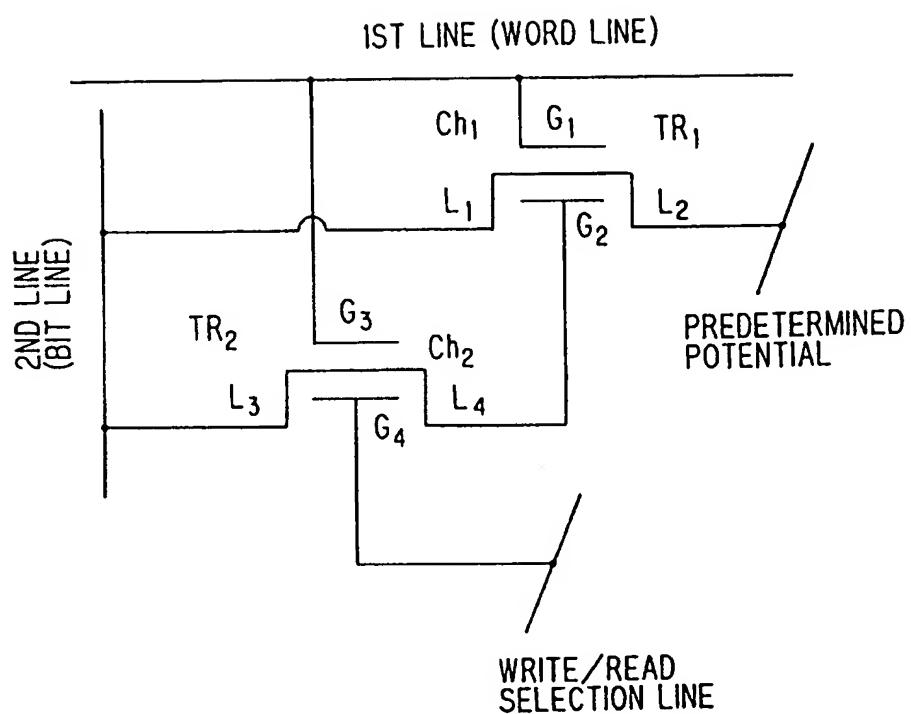


FIG. 8

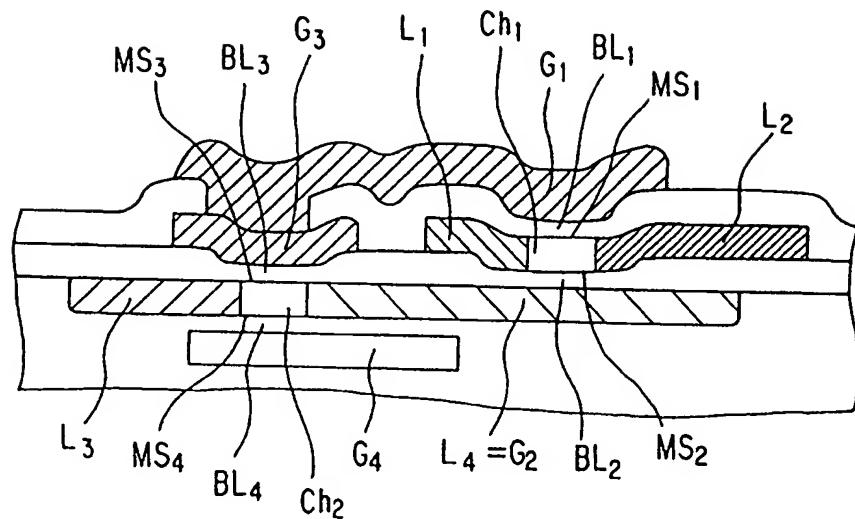


FIG. 9

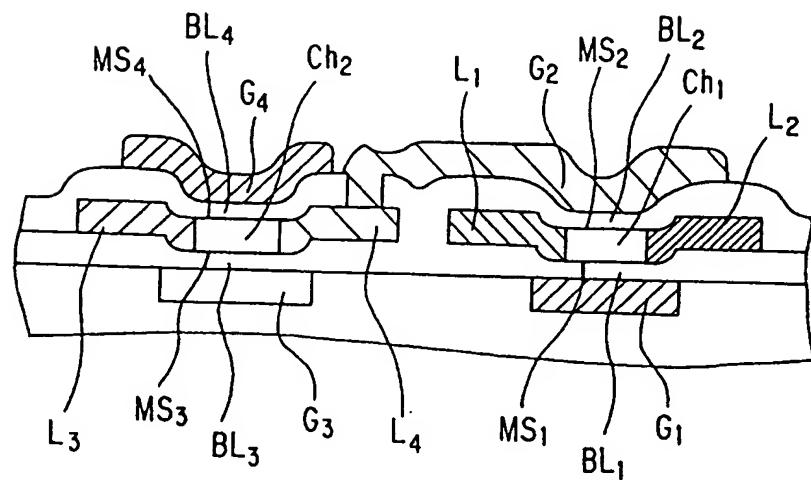


FIG. 10

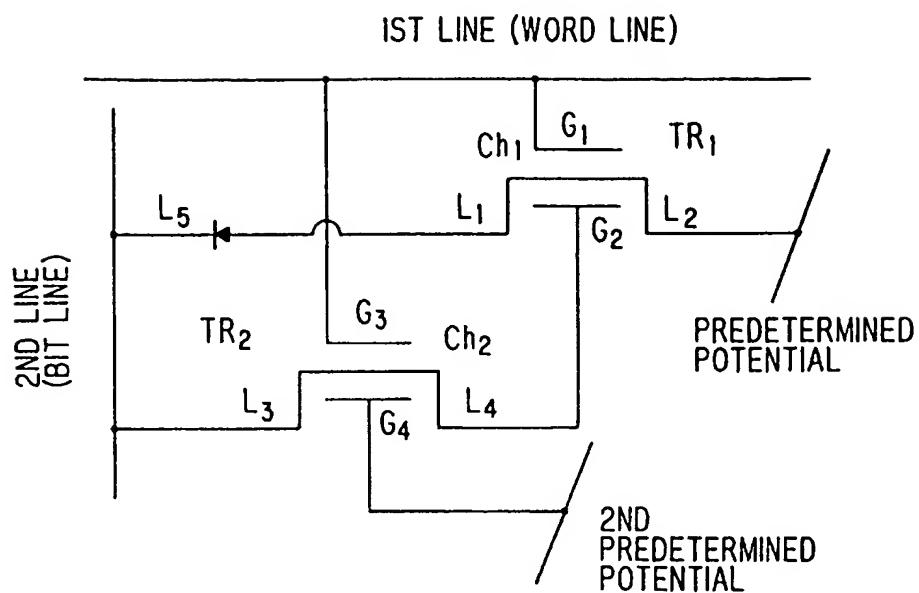


FIG. 11

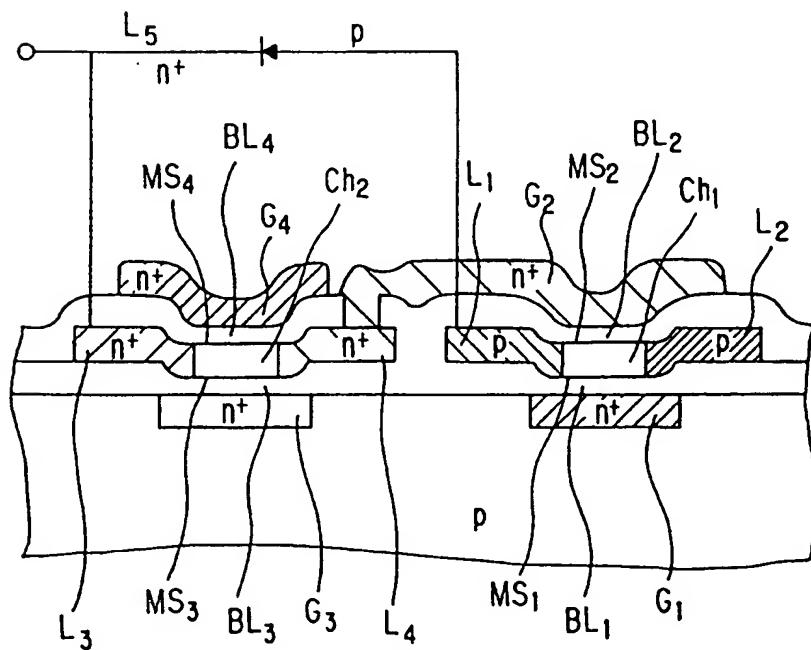


FIG. 12 PRIOR ART

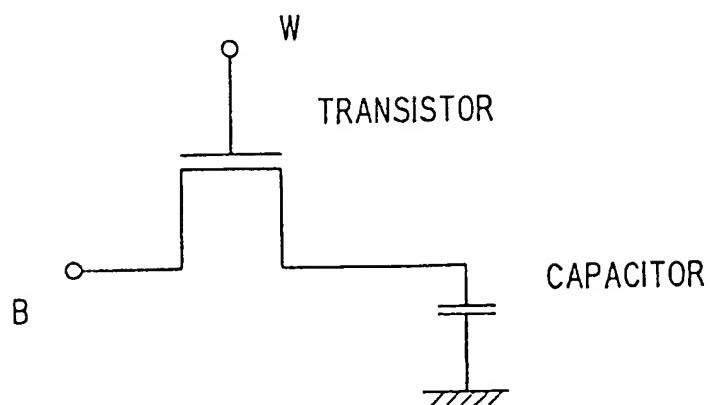


FIG. 13

